

Integrated Design Capability / Instrument Synthesis & Analysis Laboratory

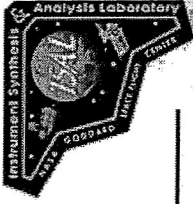
NEW DEVELOPMENTS AT NASA'S Instrument Synthesis & Analysis Laboratory (ISAL)

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NASA GODDARD SPACE FLIGHT CENTER

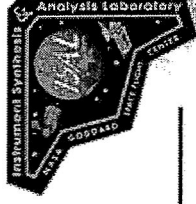


A Parallel Non-Stop Design Effort

Instrument Synthesis & Analysis Laboratory

- ISAL is designed to greatly increase the efficiency in developing an instrument concept for a proposal team
- The science team pays a fee for the ISAL study in order to fund software and state-of-the-art computing and communications capability
- The science team is put in a room with an ISAL - selected engineering team in order to iterate an instrument design in a parallel non-stop design effort until it is ready
- Previously, this parallel effort took one to two weeks but was found to be less smooth than expected
- An instrument design is sequential in nature:
 - The optical design had to precede the mechanical and thermal designs
 - The structural analysis needed to have the complete mechanical design in order to evaluate the model and recommend improvements
 - The Price H cost model depends on a complete mass rack-up for the instrument which is normally only available on the last day of the study
- **Something had to be done!**



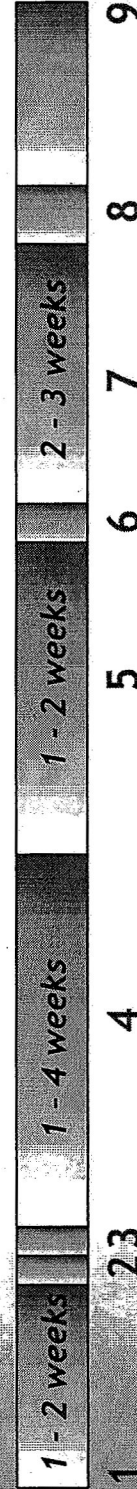


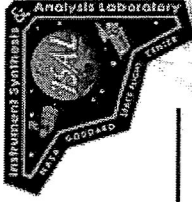
Original ISAL Study Milestones

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1. Customer enters a Request for Support (RFS) on the Integrated Design Capability website: <http://idconline.gsfc.nasa.gov/>
2. Team Lead schedules a prework meeting with the customer team (and strongly encourages the customer to complete the prework form)
3. Team Lead assigns engineers to the study (and directs them to the prework form when/if it becomes available)
4. ISAL provides prework support, especially to develop the optical design
5. ISAL Study occurs over 1 to 2 weeks
6. ISAL Presentation - usually Friday afternoon
7. ISAL Wrap-Up Activity - corrections and consistencies
8. Deliver ISAL Final Product to Customer
9. Request formal customer feedback

Typical ISAL Study Timeline





ISAL Study Process

Instrument Synthesis & Analysis Laboratory

- **Rapid design of instruments**
 - From a conceptual design or simply a measurement requirement
 - to a modeled, analyzed, illustrated point design
 - in as little as 1 week
- **Exceptional engineering staff complemented with a science liaison**
 - Rapid, iterative engineering design environment throughout all the instrument subsystems
- **Collaborative process with the customer**
 - The customer participates throughout the entire study
 - Scheduled tag-up meetings to exchange pertinent information between engineers and the customer team
 - Focused discussions with the customer to refine requirements and identify priorities
- **Flexible, adaptable support to a wide range of requests**
 - Requirements Definition
 - End-to-End Concept Studies
 - Focused Studies/Trade studies
 - Independent Technical Assessments
 - Technology and Risk Assessments





How ISAL Develops a Conceptual Design

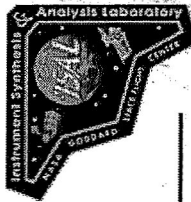
Instrument Synthesis & Analysis Laboratory

- Define the customer's objective
- Restate the measurement requirement
- Generate and sub-allocate derived requirements
- Identify and execute trade studies
- Development instrument architectures
- Select instrument components, such as detectors, mechanisms, materials
- Create structural/mechanical layout and component replacement
- Identify areas and future trades
- Develop a mass budget spreadsheet
- Document all of our findings and present to the customer



Multi-Disciplined Development

Instrument Synthesis & Analysis Laboratory



ISAL Discipline Engineers

- Science Liaison
- Instrument Systems
- Optical
- Electro-Optical
- Electrical
- Electro-Mechanical
- Opto-Mechanical
- Structural
- Mechanical Analysis
- Thermal
- Cryogenics
- Detectors
- Lasers
- Flight Software
- Risk Assessment
- Cost Modeling

Each discipline prepares a presentation that addresses

Our Products

- Science Requirements
- Derived Requirements
- Baseline Design
- Alternative Designs and Trade Studies
- Functional Diagrams
- Interfaces
- Detailed estimates of
 - Mass
 - Power
 - Data Rate
- Technical Risk Assessment
- Issues and Concerns
- Conclusions and Recommendations
- Background Information



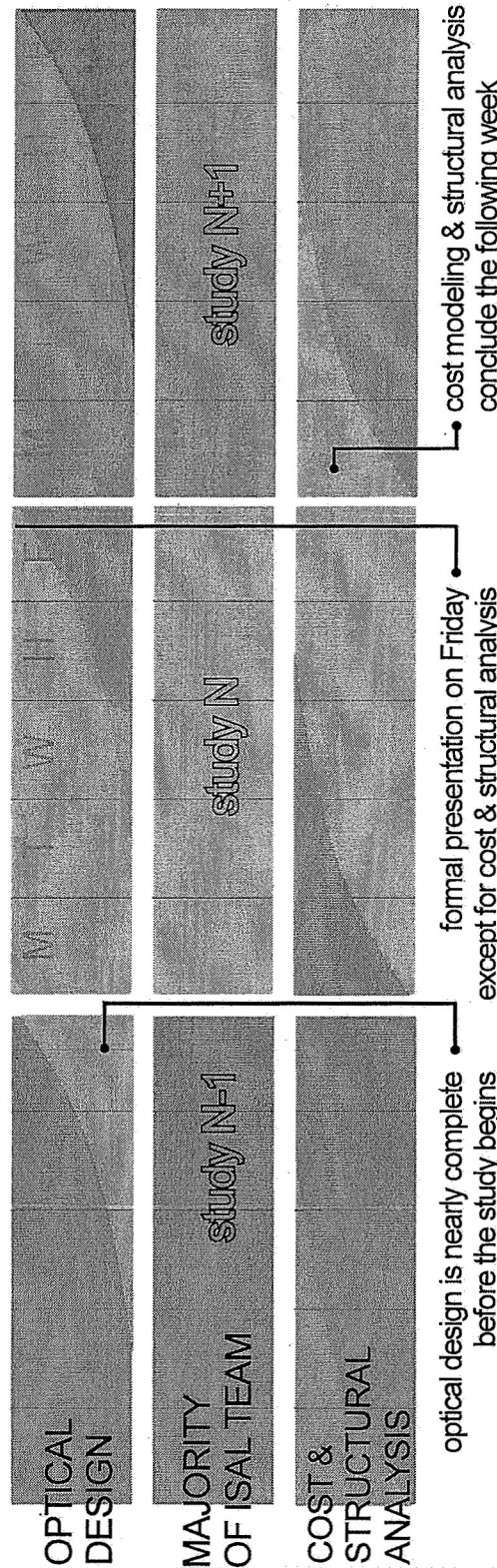
New ISAL Staggered Support Strategy



Instrument Synthesis & Analysis Laboratory

Now the study is spread out over 3 weeks sequence with the main collaborative work done in the second week

Costs the customer 1 week of time, but is distributed over 3 weeks





Drawing from a Wealth of Resources

Instrument Synthesis & Analysis Laboratory

- **Laboratory with a proven history**

- Completed 100+ studies successfully
- Experience and service for Earth Science and Space Science
- Efficient processes and tools

- **State of the Art Facility**

- Utilizes computers with the latest hardware and software for discipline use
- Conferencing capability for scientists and engineers who cannot be present

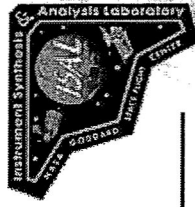
- **Exceptional Engineering Team**

- Provides a cadre of skilled engineers from all of Goddard's Branches, complemented with a Science Liaison
- Unified operations and management with the Integrated Mission Design Center (IMDC) to form the Integrated Design Capability (IDC) to assess instrument design and mission parameters together



Typical ISAL Instruments

Instrument Synthesis & Analysis Laboratory



- Spectrometers
- Lidars
- Cosmic Ray Telescopes
- X-ray Telescopes
- Solar Physics Instruments, Spectroheliographs
- Passive or Microwave Radiometers
- Infrared Cosmology Instruments and Telescopes
- Optical Molecular Sensors
- Planetary Orbiter Instruments
- Large Weather Satellite Instruments

Which would vary depending on the type of mission they're designed for

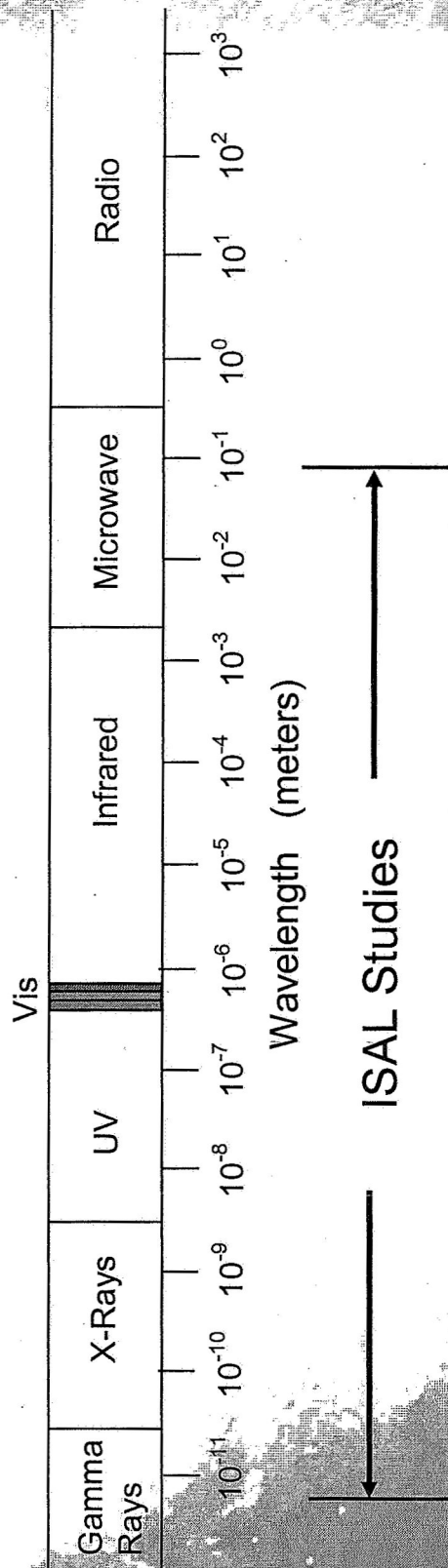
- Low Earth Orbit (LEO)
- Highly Elliptical Orbit (HEO)
- Geostationary Earth Orbit (GEO)
- Libration orbits
- Interplanetary and deep space
- Single spacecraft missions or Formation/Constellation flying
- Balloon flights



We Cover the Spectrum

Instrument Synthesis & Analysis Laboratory

The ISAL supports studies for instrument concepts in Space Science and Earth Science, and the instruments developed make measurements at wavelengths across the entire electromagnetic spectrum.

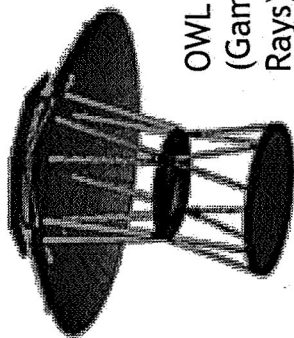


From x-ray sky surveys to UV-visible instruments for solar and planetary physics to passive and active microwave radiometers for Earth observing, the ISAL covers the spectrum.

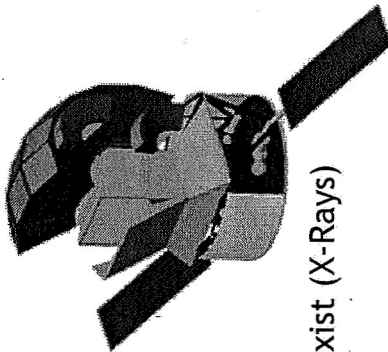


Some ISAL Concepts that grew into Mature Designs

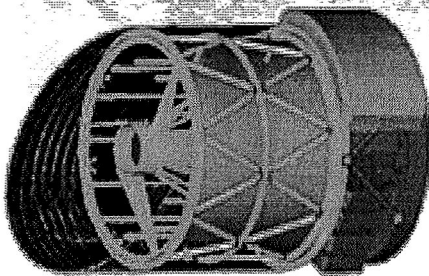
Instrument Synthesis & Analysis Laboratory



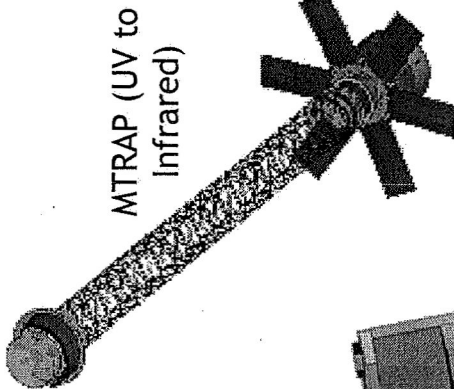
OWL
(Gamma
Rays)



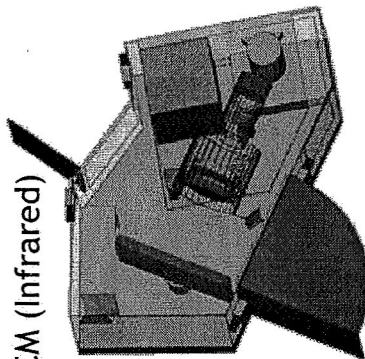
Exist (X-Rays)



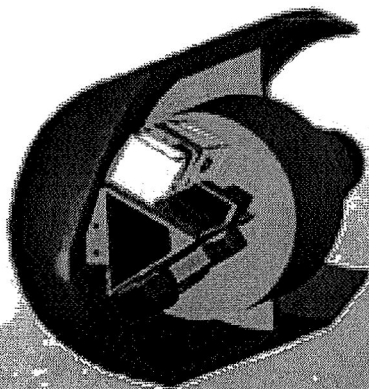
SNAP (UV
to Infrared)



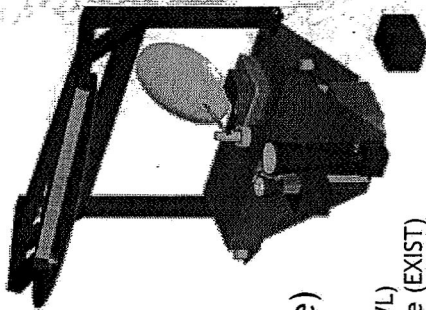
MTRAP (UV to
Infrared)



LDCM (Infrared)



SDO (EUV)



GPM-I
(Microwave)

Orbiting Wide-angle Light-collectors (OWL)
Energetic X-ray Imaging Survey Telescope (EXIST)
Magnetic Transition region Probe (MTRAP)

Landsat Data Continuity Mission (LDCM)
Global Precipitation Measurement (GPM) Mission
Solar Dynamics Observatory (SDO)
Supernova/Acceleration Probe (SNAP)



ISAL Sample Product Structural Analysis

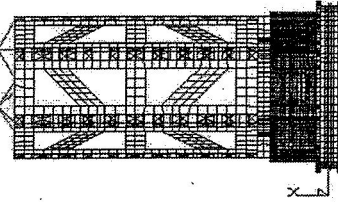
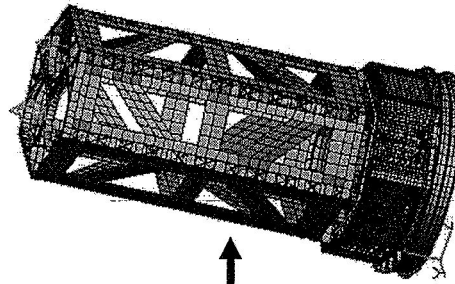
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Dynamics

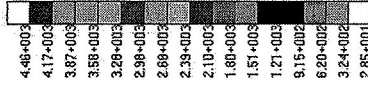
CAD Concept



Finite Element
Model

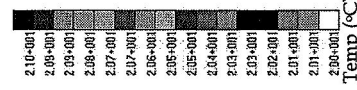
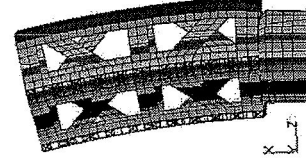


Stresses



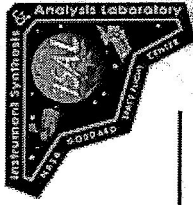
Stress (psi)

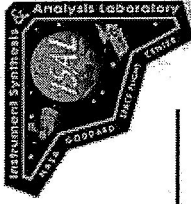
Structural Deformation



Temp (°C)

Analysis Process & Products





Conclusion

Instrument Synthesis & Analysis Laboratory

- **WEEK number:**
- 1. New studies start with the optical designer working with the team lead, science liaison and the customer team to define and create the optical design
- 2. Then the whole team works for a week in the ISAL iterating the design yielding a point design
- 3. Finally, the structural analysis is done and the cost model can be developed - product delivered
- **RESULT:**
- Customers pay for 1 week; get 3 weeks engineering work

